Modern Chemistry.

Traité de Chimie Générale. Par Prof. W. Nernst. 2e édition française, complètement refondue d'après la 10e édition allemande par Prof. A. Corvisy. Première Partie : *Propriétés Générales des Corps—Atome et Molécule.* Pp. viii + 620. (Paris : J. Hermann, 1922.) 30 francs net.

PROF. NERNST'S monumental treatise on general chemistry is so well known in this country and in America that no commendation of it is needed. It is a standard work in Germany, where it has already gone through numerous editions. In its French dress it has established a position in other parts of Europe and in Latin America. The volume under review—a large octavo of more than 600 pages—is the first part of the second French edition ; it has been thoroughly revised in conformity with the latest German edition. It deals with the general properties of matter and with atomic and molecular theories in the light of contemporary knowledge. In effect it is a treatise on the application of the fundamental principles of modern physics to chemistry, with due regard to inquiries wherever the study of chemical physics is actively pursued. Indeed, the wealth of bibliographical reference is one of the most commendable features of the work. This, of course, is as it should be. Science knows no national boundaries. This was not always so recognised in Germany. In times not so very remote it was not unusual to notice a tendency to make the world believe that the study and development of physical science, and particularly chemistry and physics, had become almost the exclusive function and prerogative of German professors. Instances were not unknown of actual appropriation of other men's work or of the wilful suppression of all mention of their labours. No such charge could possibly be brought against the author of this work. He apparently keeps his eyes open to all sources of knowledge and welcomes evidence from any quarter.

Although the general plan of the work is unchanged, the alterations and additions in the present French edition are very considerable. Many of the paragraphs have been greatly modified, and in some cases wholly rewritten ; others have been added ; some of the less important have been shortened and even discarded, so as to keep the book within bounds. Theoretical conceptions and new developments which found no mention in the first edition, such as the quantum theory, the constitution of the atom, the new thermodynamical theorem, the theory of relativity, atomic numbers, equations of state, the molecular theory of the solid state, the frequency of atomic vibrations, the elucidation of crystal structure by X-rays, radioactivity, isotopism, etc., now find their appropriate place and are dealt with at due length. The book is eminently readable, and the mathematical treatment in no wise deterrent. Prof. Nernst's excellence as an expositor has in no sense suffered by the clarity and precision of Prof. Corvisy's rendering. The book is remarkably free from typographical errors, although, as might be expected in a volume of its size, a few mistakes occur here and there. It will be news to many readers that a Lord Rayleigh developed a certain formula relating to gaseous mixtures so far back as 1587.

Text-books of Elementary Mathematics.

(1) *Elementary Calculus.* By Prof. William F. Osgood. Pp. ix + 224. (New York : The Macmillan Company ; London : Macmillan and Co., Ltd., 1921.) 12*s.* 6*d.* net.

(2) *Calculus for Beginners : A Text-book for Schools and Evening Classes.* By H. Sydney Jones. Pp. ix + 300. (London : Macmillan and Co., Ltd., 1921.) 6*s.*

(3) *A First Course in the Calculus.* Part 2, *Trigonometric and Logarithmic Functions of x, etc.* By Prof. William P. Milne and G. J. B. Westcott. (Bell's Mathematical Series for Schools and Colleges.) Pp. xv + 181-402 + xv-xxxix. (With answers.) (London : G. Bell and Sons, Ltd., 1920.) 5*s.*

(4) *Exponentials Made Easy, or The Story of "Epsilon."* By M. E. J. Gheury de Bray. Pp. x + 253. (London : Macmillan and Co., Ltd., 1921.) 4*s.* 6*d.* net.

(5) *Mathematics for Technical Students : Junior Course.* By S. N. Forrest. Pp. viii + 260. (With answers.) (London : Edward Arnold, 1920.) 7*s.* 6*d.* net.

(6) *Elementary Algebra.* Part 2. By C. V. Durell and R. M. Wright. (With answers.) (Cambridge Mathematical Series.) Pp. xxiii + 253-551 + xlvii-lxxxv. (London : G. Bell and Sons, Ltd., 1921.) 5*s.* 6*d.* net.

(7) *A Concise Geometry.* By Clement V. Durell. (Cambridge Mathematical Series.) Pp. viii + 319. (London : G. Bell and Sons, Ltd., 1920.) 5*s.* net.

(8) *Co-ordinate Geometry (Plane and Solid) for Beginners.* By R. C. Fawdry. (Bell's Mathematical Series for Schools and Colleges.) Pp. viii + 215. (London : G. Bell and Sons, Ltd., 1921.) 5*s.*

(9) *Elements of Practical Geometry : A Two Years' Course for Day and Evening Technical Students.* By P. W. Scott. Pp. v + 185. (London : Sir Isaac Pitman and Sons, Ltd., 1921.) 5*s.* net.

(1) PROF. OSGOOD'S "Elementary Calculus" supplies a need—the need of the young mathematician for a sound introduction to the differ-

ential calculus. The treatment is almost without blemish and is so simple and clear that the beginner should have no serious difficulty. Chaps. 1-4 introduce only algebraic functions; chaps. 5-8 are concerned with trigonometric and exponential functions and the corresponding inverse functions. The treatment of infinitesimals and differentials in chap. 5 is specially to be commended. The author has one or two hobby-horses. One that he ought not to have ridden here is the denial of the existence of "infinity." He says (p. 27): "We should not read 'Z approaches infinity,' . . . but 'Z becomes infinite'; . . . the statement sometimes made that 'Z becomes greater than any assignable quantity' is absurd. There is no quantity greater than any assignable quantity." This last remark contains a certain misunderstanding, and, in any case, such subtleties are not suited to beginners. Among minor points it is curious to note that there is no definition of a limit in the book. Some proof, or at least a reference, should be given for the proposition quoted on p. 113: "A convex curved line is less than a convex broken line which envelops it and has the same extremities."

(2) It is a pity that authors who do not "make reference to difficulties which seldom arise in the minds of elementary students" generally manage to make their subject so uninteresting. We do not ask for proofs. Mr. Sydney Jones effectually suppresses such an unreasonable desire by putting the word "proofs" in inverted commas in his preface. But could we not have a little colour? Let us take MacLaurin's theorem as a sample (p. 158). Mr. Jones says: "Assuming that a function $f(x)$ can be expanded in positive integral ascending powers of x . . . .

$$f(x) \equiv A_0 + A_1x + A_2x^2/1.2 + \ . \ . \ . \ ,$$

to determine the coefficients A_0, A_1, A_2, . . ." He then differentiates the series and determines the coefficients, as if this were a most ordinary and most dull proceeding. His pupils no doubt wonder vaguely, learn their lesson by rote, and pass on. If he would only pause to tell them what a wonderful theorem this is, or point out how great are the assumptions he is making, it would be well worth the space. Judging the book from the author's own point of view, there is little to find fault with in it. But he should not call a differential coefficient a "differential" (p. 18, etc.).

(3) This misuse of the word "differential" is a bad habit that appears to be gaining ground. The authors of "A First Course in the Calculus" are also addicted to it (preface and p. 215). Their text-book is mainly manipulative; it contains the usual treatment of the infinitesimal calculus, and concludes with a chapter on differential equations. The proof, depending on the area of a circular sector, for the limit of sin θ/θ (p. 181), is open to the objection that students are generally taught to use the limit in question for finding this area. It is not necessary to use a formula for an area at all (see, for example, Levett and Davison's "Plane Trigonometry," p. 82). Many mathematicians would be pained by the author's statement on p. 343: "If we proceed indefinitely, taking only a fractional part of a given object, it is perfectly plain that the fractional portion will soon be very small indeed." There is no doubt that an intelligent person can convince himself that the limit of x^n is zero, if x is less than unity, but a more exacting logician demands a proof of the proposition. The authors hope that "the student will have nothing to unlearn if he afterwards . . . proceeds to a rigorous course of modern analysis." But it would be a pity if he learnt to regard analysis as the proving of the "perfectly plain."

(4) Mr. Gheury de Bray calls his book a "little brother" of "Calculus Made Easy." We do not know whether the late Prof. S. P. Thompson would have been pleased with this facetious little relative. The only portion of the work that we can unreservedly recommend is a long preliminary quotation from Henri Fabre (pp. 1-12). There follow part 1 on indices, binomial series, etc., and part 2 on the exponential series, the equiangular spiral, the hyperbola (because its area is a logarithmic function), the catenary, the parabola (because it resembles a catenary), the probability curve, and "exponential analysis." The method consists in "talking round" the subject; something may be said for it, but it requires skilful handling, and in this author's hands it is often long-winded and obscure. The unwary should be warned that the method, which is stated on p. 55, is not "mathematical induction," but a kind of sampling; the statement on p. 147 that the centroid of a catenary arc is its middle point is, of course, incorrect. The last chapter is interesting, but too difficult for any one who would care to read the rest of the book. In sum the author had an excellent idea, which he has not quite managed to realise.

(5) "Mathematics for Technical Students" is designed for the first two years' work following on an elementary school course. The treatment is apt to be rather too formal in places—Mr. Forrest teaches algebra in the old style like a game of patience with x's and y's for playing cards, and only hints that algebra has something to do with the workaday world after his pupil has learnt to play the game. The treatment is, of course, still quite defensible, but it is now generally thought better to reverse this order

with technical students, who are only too apt to regard mathematics as a game instead of an essential part of their business. The book is, for the rest, well proportioned and quite suitable for its purpose.

(6) The subject known as "Elementary Algebra" has been so metamorphosed in the past ten or twenty years that its name ought to be changed. Graphs, differentiation, integration, and nomography are not algebra as understood by Salmon, Chrystal, or Weber. A little trigonometry and as much geometry as is required should be added and the whole called elementary mathematics. The breaking down of the watertight compartments into which school mathematics used to be divided is a development in the right direction.

The scheme of this book is interesting. The bookwork is only given in outline in the text or hinted at in the introduction. It remains for the teacher to fill in this framework according to his own lights. And then the text-book gives him examples that are both numerous and apposite. The scheme has much to recommend it, and will be welcomed by teachers who are accustomed to do their work thoroughly. The authors need not apologise for introducing a chapter on nomography, although this chapter will be found difficult without a much fuller treatment.

(7) It is a melancholy fact that examinations dominate and thereby spoil much of the education that they are intended to test and encourage. A considerable part of the education in this country has no higher purpose than the passing of a public examination at some future date. Mr. Durell, who is capable of much better things, says quite frankly that he has compiled a cram book, and we can recommend it for that purpose. The range is roughly that of the Cambridge schedule.

(8) The syllabuses for the Army entrance examinations and those conducted by the Oxford and Cambridge Joint Board have been assimilated, in the hope that Army classes at public schools may thereby be discontinued. This is a little unfortunate for Mr. Fawdry, whose "Co-ordinate Geometry" is written for Army candidates. But the book should prove quite suitable for the general classes into which the Army classes may be merged. Mr. Fawdry has the humanity to insert one or two historical notes (pp. 29 and 75). They are slight, but it is wonderful how much interest they add to the reading. We should like to see more of them.

(9) One of the difficulties of the teacher of modern elementary geometry is the devising of life-like examples. He will solve this difficulty if he gets Mr. Scott's text-book on practical geometry. The text-book is meant for young draughtsmen, and is full of such things as draughtsmen have to draw. The only general criticism we would make is that, while Mr. Scott gives clear instructions, he never justifies them, and we cannot believe that rule of thumb is a good rule even for draughtsmen. Chap. 8, about which the author is a little apologetic, is rather out of place. It contains some methods of constructing a "true length," when plan and elevation are given. The chapter is good in itself, but it stands at a different level from the rest of the book. The subject should be either left out or treated more fully. Standing alone, it will not be understood by the majority of readers.

H. B. H.

Studies in Symbiosis.[1]

Tier und Pflanze in intrazellularer Symbiose. By Prof. P. Buchner. Pp. xi + 462 + Tafel 2. (Berlin: Gebrüder Borntraeger, 1921.) 114 mk.

THE third section of Dr. Buchner's book deals with the highly controversial thesis that symbiotic bacteria are the cause of luminosity in many insects and marine animals. In this discussion, the author's critical faculty is at fault. He does not set out clearly the opposing lines of evidence nor does he do full justice to the work of Dubois, the protagonist of the "enzyme-theory" of animal luminosity.

Briefly, the issue is between the enzyme and the bacterial modes of light production. According to Dubois and Newton Harvey (whose work was reviewed in Nature, October 6, p. 174), luminous animals contain two substances, one of which, when oxidised in the presence of the other, gives rise to light of an extremely "efficient" kind. The firefly's light is the standard—the most efficient light known, so far as the amount of light in relation to the expenditure of energy is concerned. One of these substances is a heat-stable, dialysable, oxidisable light producer, the other is not heat-stable, is non-dialysable, and is apparently a proteid. These substances are obtained by "dissolving" whole animals or their phosphorescent mucus in water or alcohol and precipitating with ammonium sulphate. No attempts appear to have been made to test the solutions for the presence of bacteria. An aqueous emulsion boiled in 20 per cent. hydrochloric acid for three hours retains the power of producing light when added to a cold-water emulsion. In the former the heat-stable "luciferin" has been separated from the unstable catalyst "luciferase," while both are present in the cold-water extract. The presence of the activator is necessary for light

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[1] Continued from p. 539.